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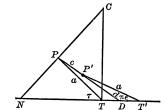
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The pseudosphere is obtained by rotating the tractrix about its asymptote. That its total curvature is constant may be proved as follows: In any surface of revolution the principal radii of curvature are the radius of curvature of the meridian section and the length of the normal at the given point (Goursat-Hedrick, vol. 1, p. 505). As is well known the length of the tangent for the tractrix is a constant a; in fact, this is usually given as its definition. Let P and P' be two neighboring points on a tractrix, PT = P'T' = a the tangents at these points, and τ and $\tau - \epsilon$, their acute inclinations to the axis. Produce PP' = c to cut the axis in D and set P'D = d; then

$$\frac{c+d}{d} = \frac{a\,\sin\,\tau}{a\,\sin\,(\tau-\epsilon)} \qquad \text{or} \qquad \frac{c}{d} = \frac{\sin\,\tau - \sin\,(\tau-\epsilon)}{\sin\,(\tau-\epsilon)}\,.$$

Thus

$$\frac{c}{\epsilon} = d \, \frac{\cos \left(\, \tau \, - \frac{\epsilon}{2} \, \right)}{\sin \left(\tau \, - \, \epsilon \right)} \, \frac{\sin \frac{\epsilon}{2}}{\frac{\epsilon}{2}}.$$



As ϵ approaches zero, d approaches a and c/ϵ approaches the radius of curvature R. Hence $R=a\cot\tau$, and this shows that the line joining the center of curvature C with T is perpendicular to the axis. If PN is the normal at P, the right triangle CTN gives $CP\times PN=a^2$. (See Goursat-Hedrick, vol. 1, p. 441 for an analytical proof.) Thus the total curvature at every point of the pseudosphere is $-1/a^2$ and the torsion of an asymptotic line is 1/a.

Also solved by J. B. Reynolds.

2782 [1919, 311]. Proposed by WARREN WEAVER, University of Wisconsin.

A great number, n, of jackstraws are jumbled up in such a way that any one is as likely to have one direction as another. Show that the probable number that make an angle lying between θ_1 and θ_2 as measured from any given direction is equal to $\frac{n(\cos\theta_1-\cos\theta_2)}{2}$.

Solution by H. L. Olson, University of Wisconsin.

Let us imagine the jackstraws all to have been translated in space so as to have corresponding ends coincident, and let us consider a sphere of unit radius with its center at this common endpoint. The jackstraws satisfying the specified condition will then intersect the sphere in the points of a zone whose bases are circles with angular radii θ_1 and θ_2 , respectively. Since the area of this zone is $2\pi(\cos\theta_1-\cos\theta_2)$ (if $\theta_1<\theta_2$) and the area of the entire sphere is 4π , the probable number of jackstraws making angles between θ_1 and θ_2 with a given line is $\frac{n(\cos\theta_1-\cos\theta_2)}{2}$.

2789 [1919, 414]. Proposed by KURT LAVES, University of Chicago.

Given a quadrilateral ABCD for which $|AC - BC| > |AD - BD|^1$ (AC + BC < AD + BD) to construct, by means of the ruler and compass only, the pair of tangents from D to the hyperbola (ellipse) for which A and B are the foci and C a point on the hyperbola (ellipse).

Solution by A. Pelletier, Montreal, Can.

Ellipse: D is outside the curve and the solution is always possible. With B as a center and a radius of length AC + BC describe the circle x; with D as a center and DA as a radius, describe the circle y. The circles x and y intersect at M and N. The perpendiculars erected on AM, AN, at the mid-points of these lines are the required tangents, as is well known.

Hyperbola: The construction is the same as above, the radius of x being |AC - BC|.

¹ This expression was inadvertently omitted when published originally.